Before The
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Access Charge Reform	)	CC Docket No. 96-262
	)	
Price Cap Performance Review	)	CC Docket No. 94-1
for Local Exchange Carriers	)	
	)	
Transport Rate Structure	)	CC Docket No. 91-213
and Pricing	)	
	)	
Usage of the Public Switched	)	CC Docket No. 96-263
Network by Information Service	)	
and Internet Access Providers	)	
	)	

Comments of
Services-oriented Open Network
Technologies, Inc.
(SONETECH)

Services-oriented Open Network Technologies, Inc. (SONETECH) submits its comments in response to the Commission's Notice of Proposed Rulemaking (NOPR), Third Report and Order, and Notice of Inquiry (NOI)).

Regarding Regulation of Terminating Access (Section VIII, A), SONETECH offers the following comments.

The concept of paying a Local Exchange Carrier (LEC) for access to its customers for interexchange calls was created at divestiture. At that time it was decided to allow LECs to charge for both originating and terminating access.

With implementation of the Telecommunications Act of 1996, both LECs and interexchange carriers (IXCs) can carry both local and inter-LATA calls. Some form of payment is due to a customer's LEC of choice when that customer selects an IXC other

than the LEC to carry interexchange traffic. The rates charged for such access must be regulated with price caps to prevent both incumbent LECs (ILECs) and non-incumbent or competitive LECs (CLECs) from anti-competitive behavior.

It is important in the case of terminating access that the Commission not create an artificial differentiation between equivalent telecommunications functions. The function of terminating a call to a LEC's subscriber which originates on another network is the same whether the call originates within the LATA from another LEC or outside the LATA and is delivered by an IXC. The cost for a LEC to terminate a call which originates external to its network is identical whether the call originates inside or outside the LATA, so long as the call is delivered to the terminating LEC's designated tandem and the cost of the transport from the originating network to the terminating LEC's network is born by the carrier wishing to terminate calls on the LEC's network. The concept of charging for both originating and terminating access is an artifact of divestiture.

Thus, **we recommend that the Commission eliminate terminating inter-LATA access charges altogether**, with an appropriate increase in the originating access charge to compensate the LEC for the loss of terminating revenue. The actual pricing for local interconnection between competing LECs (the equivalent function to inter-LATA termination) will be set by the states. In many cases, states are proposing "bill and keep" where no usage based charge is made for terminating access.

While incumbent LECs have more lines in a LATA than competitive LECs, it is generally accepted that community of interest calling is balanced. That is, if my company uses a CLEC for local service and at my home I continue with the ILEC, I call my family about as much as they call me.

The exceptions to this community of interest situation are incoming and outgoing call centers. The Commission's solution for incoming call centers ("Open End" Services, NPRM VIII, A, 3) is appropriate. For outgoing call centers (telemarketing) it seems reasonable to charge the caller for terminating access, similar to the approach now used for "Open End" Services. Consumers would certainly not mind if LECs charged exorbitant rates for such telemarketing calls (particularly if such gouging could directly offset their phone bill), however, in fairness there should be price caps here, too. These caps should apply to ILECs and CLECs equally.

We reiterate that if terminating inter-LATA access charges are not abolished, then an artificial differentiation of the same telecommunications function will be created between inter-LATA termination and local interconnection.

IXCs who are also LECs might intentionally or accidentally terminate inter-LATA as well as intra-LATA calls using local interconnection trunks. This would require that all LECs create additional operational and billing software safeguards to check the caller ID on all incoming calls received over local interconnection facilities in order to keep from being

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defrauded. This would increase the actual cost for all LECs to provide local interconnection.

Furthermore, if no artificial differentiation is made between interconnection of networks for terminating either local or inter-LATA traffic, then all LECs can benefit because they can use a single, larger, more efficient trunk group to each other LEC for both call types.

We believe the approach of making all inter-LATA access charges to be recovered on originating access (except for outgoing call center traffic) and enforcing price caps on all LECs equally addresses all the issues expressed by the Commission on NPRM Section VII, A.

The only objection even ILECs should see to this proposal is that it eliminates their natural ability to be the low cost inter-LATA carrier within their regions. However, for non-ILECs and consumers as well, such a totally level playing field may be quite attractive.

In regard to the Notice of Inquiry on Implications of Information Service and Internet Usage, SONETECH offers the following comments.

We agree that the Commission should make no rulings that would hamper the growth of packet technology. In particular, this should apply to packetized voice over the Internet including such calls which may originate from and/or terminate to conventional telephones connected to the Public Switched Network.

However, it is clear that with today's exclusion of Internet Access Providers (IAPs) from inter-LATA access charges that there is a disparity somewhere. SONETECH's engineers are experts in both telephony and packet networks. As such, it is clear to us that calls to IAPs cause LECs additional cost which they are not currently permitted to recover. The extent of these costs, while perhaps significantly less than some ILECs' claims, are still substantial. An IAP is clearly an incoming call center application. That is, many network subscribers call in to a single IAP location. We suggest that this be handled much as are inter-LATA "Open End" Services (see NPRM, Section VIII, A). We suggest that IAPs pay a usage sensitive charge for incoming calls.

Ignoring the fact that Internet access has a cost and requiring an unmentioned subsidy from LECs is a case of denial. While IAPs may respond that their paying such charges would stifle their profitability and technology growth, we totally disagree. Such access charges would stimulate progress. Just as it is natural for LECs to also be IXCs, it is just as natural for the LEC to be the IAP. What we are saying is that with the Telecommunications Act of 1996 and Internet telephony, IAPs are natural CLECs and IXCs. If they had to pay a fair price for access, many would find that it makes sense to become CLECs and IXCs. Such an incentive to IAPs would greatly stimulate the growth of packet technology.

With open local competition, a subscriber could keep his or her voice line with the ILEC and switch his or her Internet access line to the IAP. IAPs would use loop resale and digital loop carriers at ILEC end offices just as traditional CLECs do.
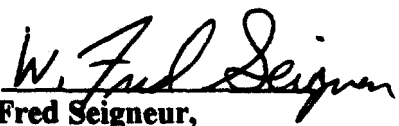
The Commission has invited "... parties to identify means of addressing the congestion concerns raised by incumbent LECs, for example by deploying hardware to route data traffic around incumbent LEC switches ...".

SONETECH proposed a new telecommunications reference architecture called the Robust Open Architecture Distributed Switching (ROADS) Model which was first proposed publicly in an article in the October 11th, 1993 issue of *Telephony* magazine. ROADS is an architecture model, not a product. The attached paper (to be delivered as the Keynote Address at the Distributed Switching and Client/Server Telephony TecForum at the 1997 Western Communications Forum, March 6th, 1997 in Colorado Springs) describes ROADS. The section subtitled **ROADS to the Superhighway** on page 28 of the attachment, explains how ILECs are using new generation Digital Loop Carrier technology to bypass end office switches for Internet access. This section of the paper describes the technical approach being used largely in ILEC networks today in detail. It should be noted that the ability of intelligent loop electronics to bypass end office switches is exactly what was predicted in the cited 1993 *Telephony* article.

We are particularly concerned at what we are seeing thus far, not with the technology, but with who is paying for what. We are concerned that ILECs may be building infrastructure with which to compete with IAPs using funding from the regulated telco side. That is, in the name of saving the PSN from overload, and with PSN funding, ILECs are building infrastructure which also makes them IAPs. The Commission, should ensure that incumbent LECs are not positioning themselves technically ready for a full blown assault on IAPs using funding from the regulated side of the business.

Respectfully submitted,

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The ROADS Model:
The Computer Industry Redefines Telecom

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For over 100 years the central office (CO) with its subtended copper lines has defined the reference architecture by which subscribers access the public switched network (PSN). *Today's digital central office switch is like the mainframe computer of the 70's: a centralized, proprietary architecture,* no longer suited to the service demands of the Information Age. SONETECH has proposed a new reference architecture called the **Robust Open Architecture Distributed Switching (ROADS) Model**. In it, switching functions are distributed to open architecture subsystems, much like functions formerly performed by centralized mainframe computers were distributed to clients, servers and LANs.

This presentation shows how ROADS is a natural (and low risk) extension of ongoing network evolution. Applications in the following areas are described:

- Incumbent LEC Network Applications

- Personal Communications Systems (PCS) Network Applications

- Cable Telephony Network Applications

- Competitive Access Provider (CAP) and Competitive Local Exchange Carrier (CLEC) Network Applications

- Third Party Service Provider Applications

For the above applications, the "next step" in current network evolution is first shown. We then demonstrate how each of these architectures can easily evolve, a step further, to the ROADS Model. Finally we describe:

- ROADS Enterprise Network Applications

- ROADS to the Superhighway

    - Internet Service Provider (ISP) Network Applications

    - Voice over the Internet Applications

    - Interexchange Carrier (IXC) Network Applications

The technologies of computers, wireline and wireless telephony and cable TV are said to be converging.
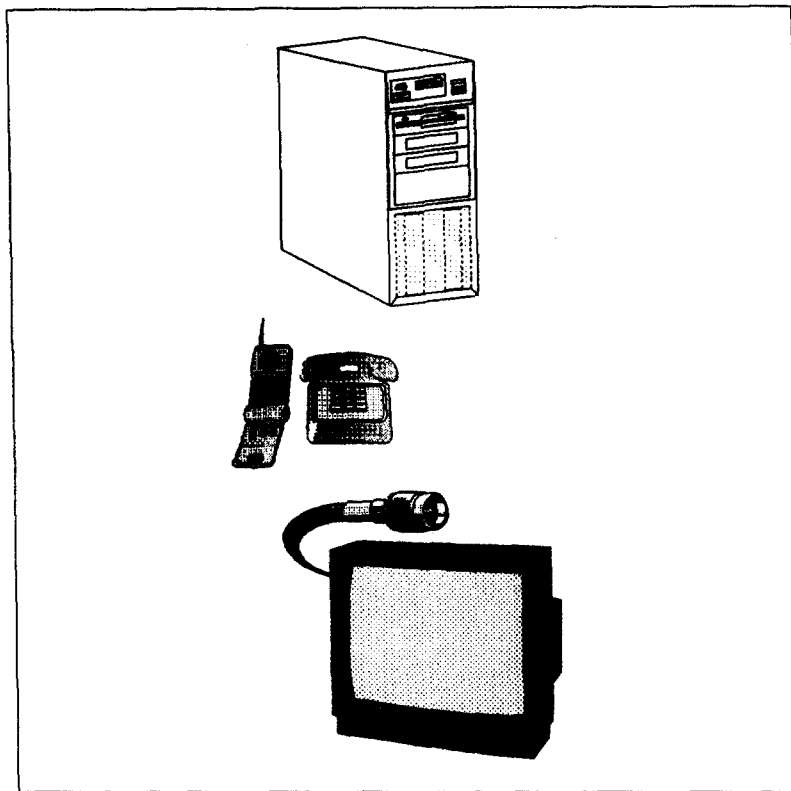
Con·verge (k..n-vûrj") v. con·verged, con·verg·ing, con·verg·es. --intr. 1.a. To tend toward or approach an intersecting point: lines that converge. b. To come together from different directions; meet: The avenues converge at a central square.

The application we will be exploring epitomizes convergence. As will be shown, it combines technologies from the world of computers and software, telephony, digital transmission systems, cable TV, and wireless in a synthesis which has the potential to impact the communications industry as much as the breakup of the Bell System.

In the late 1800s and early 1900s, Frederick W. Taylor, the "father of scientific management", analyzed work at the "phone company." In some ways his theories are similar to today's object oriented philosophy. He believed that work should be organized into very low level specialized tasks, simple enough for anybody in the labor force to learn. This would make laborers interchangeable, and thus replaceable with anyone off the street. The knowledge about how to do an overall job, or how to build a complete product would be hidden from workers in general. It is fine to treat computers and software like objects, while people obviously do not work well that way.

Within the telephone industry, Taylor's philosophy was adopted lock, stock and barrel. This resulted in the creation of specialized work units which were optimized based on internal goals, often at the cost of reduced overall efficiency. The result has been an industry subdivided into fiefdoms where the right hand doesn't know what the left hand is doing. This grossly inefficient organizational structure has been "inherited" from the original Bell System by telecommunications carriers and manufacturers worldwide. This structure, common to all industrial era corporations—auto, steel, electric power, chemicals, heavy machinery, etc.—is totally obsolete. Industry after industry is moving away from such structures.

The state of "disintegration" in Telecommunications is exemplified by the concept of the subject matter expert, or SME. SME's are very focused. SME's are so focused that it is possible to ask a SME a question and get an answer like: "I'm a zero bit SME and that was a one bit question. I'm sorry, but, I don't know the answer".

What the industry needs very much is an end-to-end systems integration approach: a convergence of telecom, CATV, computers, systems integration and software engineering.

The focus of this convergence opportunity is the Local Exchange telephone network. The figure below illustrates the Local Exchange after divestiture. The two shaded lines in the figure delineate the two areas on which we will be concentrating: The Central Office and The Local Loop.

## Telephony Local Exchange Network Architecture
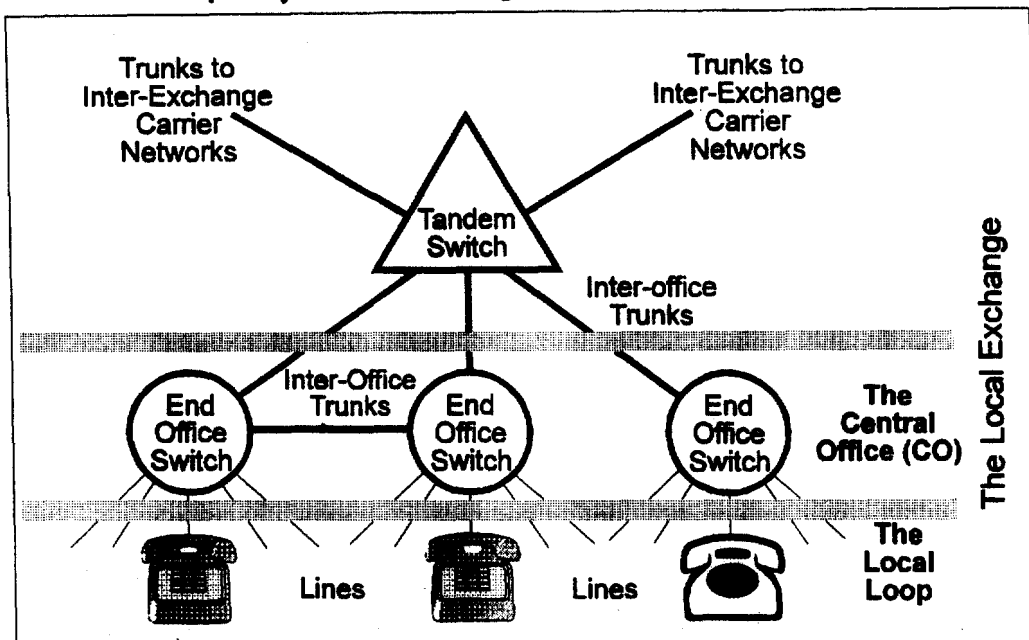
Today's state of the art digital CO switch is like the mainframe computer of the 70's: a centralized, proprietary architecture. In fact, at divestiture AT&T, realizing that the CO switch was much like a mainframe computer, planned to conquer the computer industry.
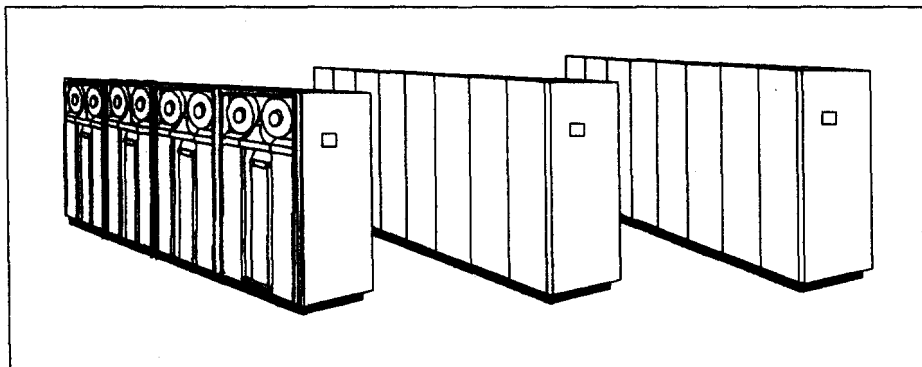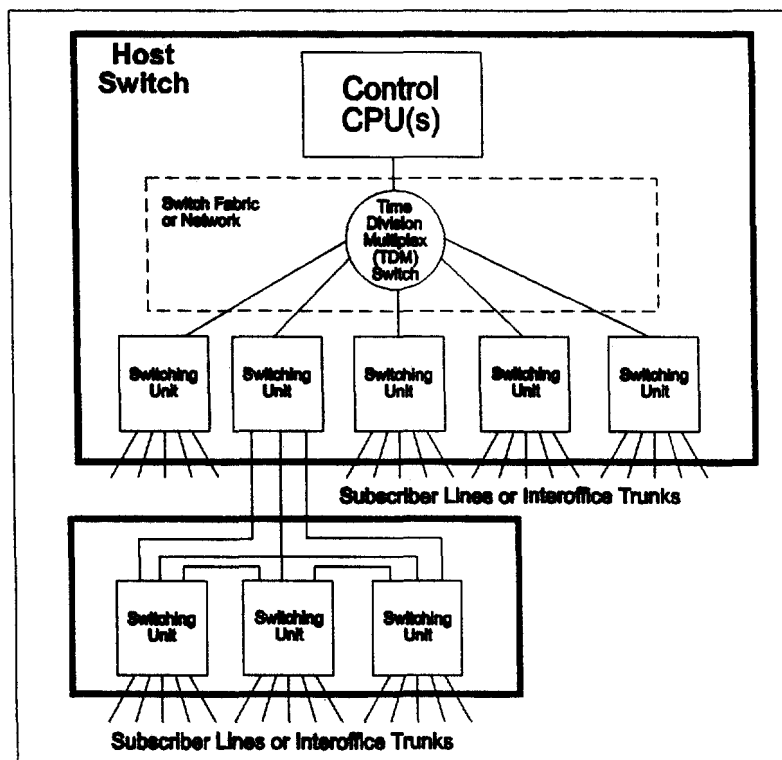
The figure below illustrates the architecture of a typical digital CO switch.
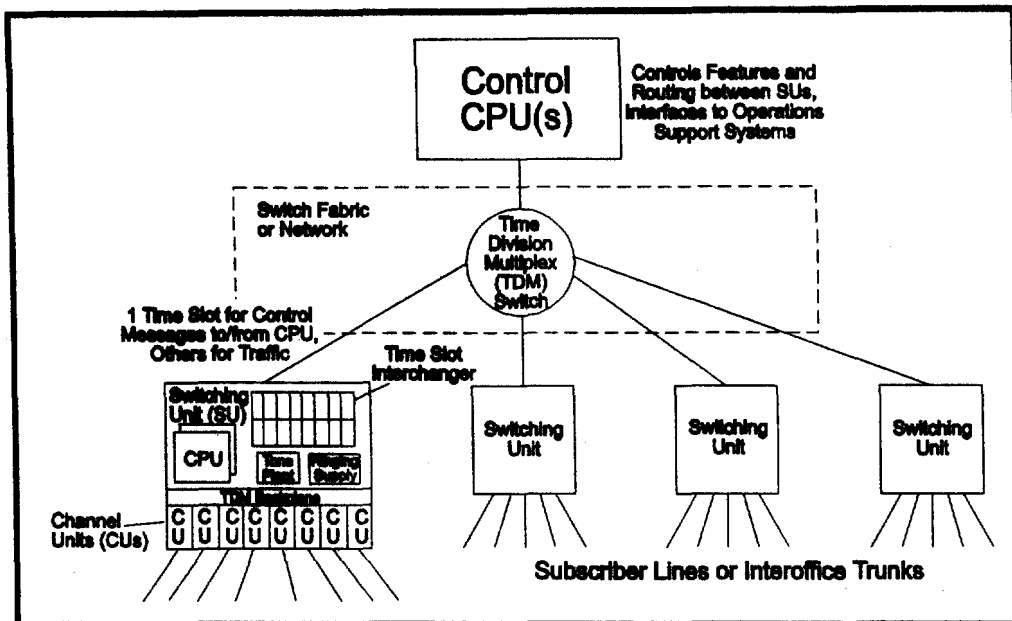
While a CO switch can be physically distributed using Remote Switch Units (RSUs), both an RSU and its interface to the host switch are proprietary. So, both the host switch and all its subtended RSUs must be from the same vendor.
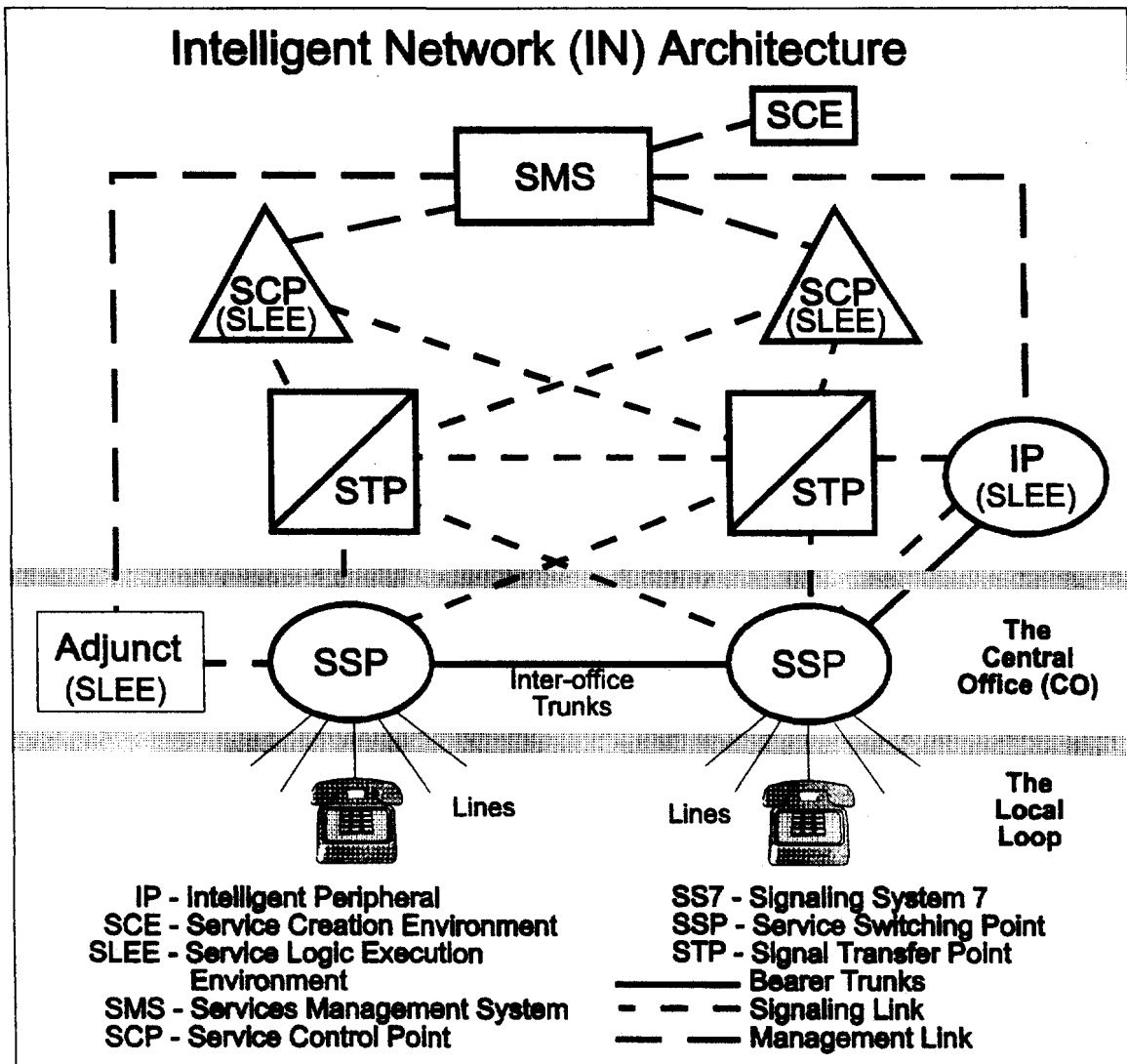
Distributed intelligence based on Open Systems led to the Open Architecture Distributed Computing Model. The functions formerly performed by centralized mainframe computers have been distributed to three major components: Clients, Servers, and LANs. Each can be provided by a number of competing vendors.

Client/Server Model

Server(s)

LAN
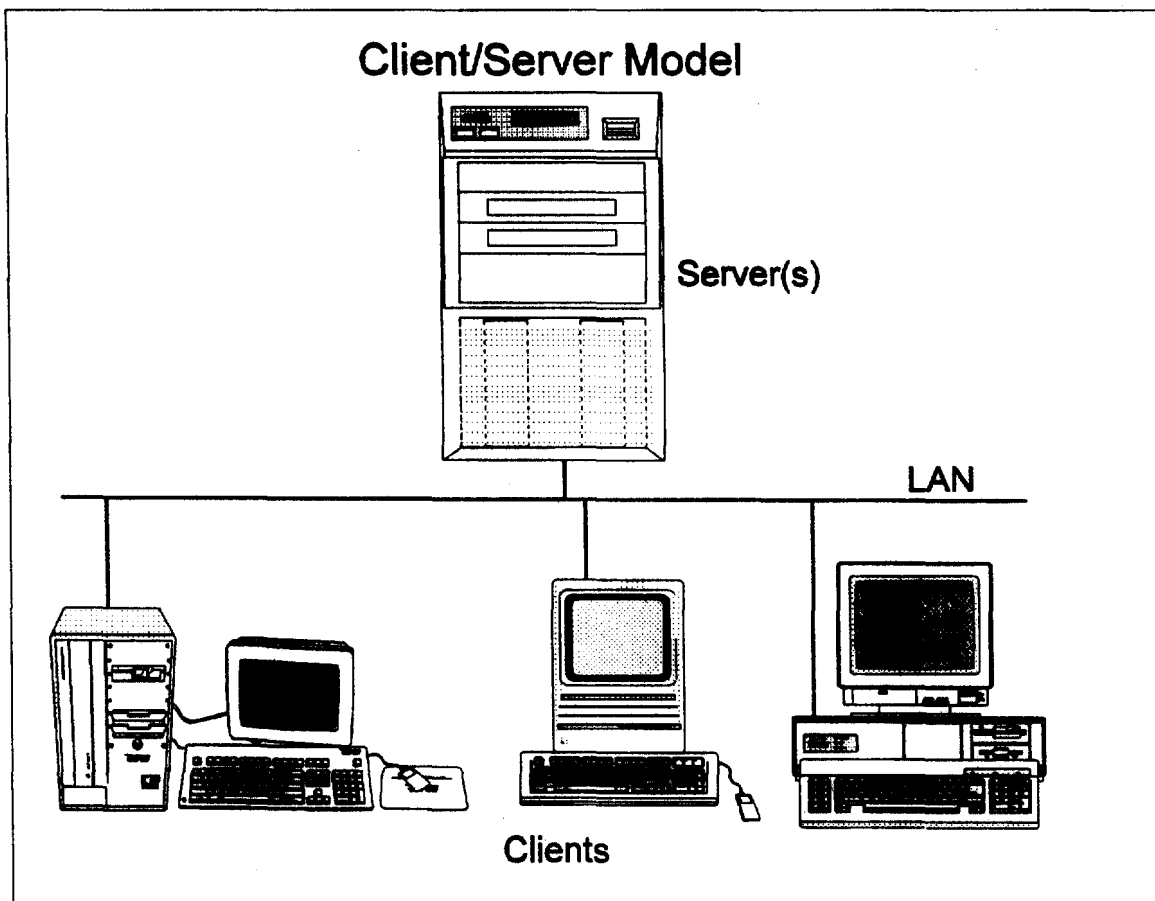
Clients

The Intelligent Network

The excessive delays and high costs of enhancing embedded switch software to add new services and features, particularly where several vendors' switches were involved, led to the application of Client/Server technology to telephony. The Intelligent Network was born.

Intelligent Network (IN) Architecture

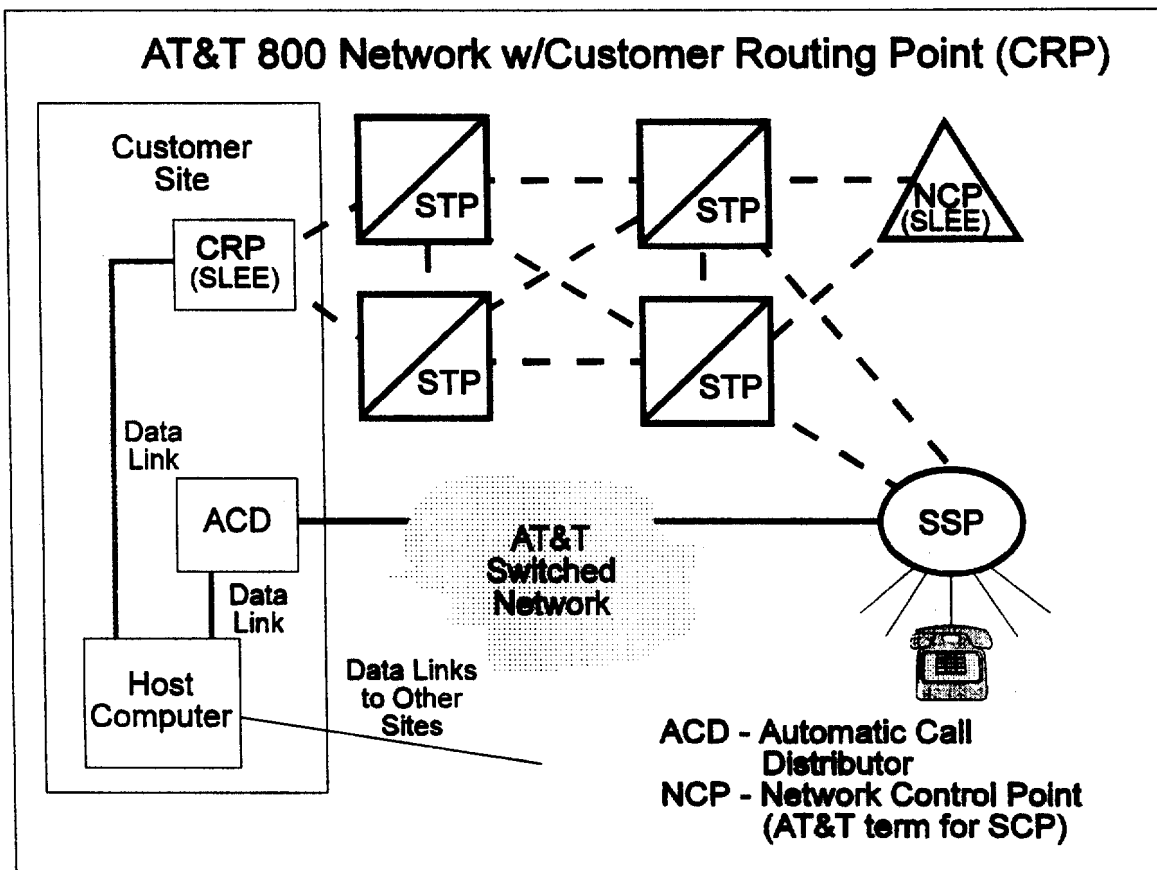| IP - Intelligent Peripheral	SS7 - Signaling System 7
SCE - Service Creation Environment	SSP - Service Switching Point
SLEE - Service Logic Execution Environment	STP - Signal Transfer Point
	———— Bearer Trunks
SMS - Services Management System	– – – Signaling Link
SCP - Service Control Point	—— —— Management Link

IN migrates software for complex services and features (called Service Logic) out of the switches and into IN based servers. These servers may be called Service Control Points (SCPs), Adjuncts, or Intelligent Peripherals (IPs) depending on their placement and function within the network. SCPs, IPs and Adjuncts all provide a standardized Service Logic Execution Environment (SLEE).

Powerful CASE tools known as Service Creation Environments (SCEs) help carriers, Enhanced Service Providers (ESPs), and sophisticated users create their own custom services and features.

Initially, SLEEs and SCEs were developed by Bellcore and switch vendors. As such, they remained proprietary and out of reach of independent systems integrators. Today several computer vendors, including HP, Tandem and Stratus have developed SLEE and SCE products. The independent software house, EBS (Shelton, CT), has developed SLEE and other SS7 software as has DGM&S of Mt. Laurel, NJ. Systems integrators such as IEX (Richardson, TX) are using such software to develop systems like the Customer Routing Point, illustrated below.

The Customer Routing Point (CRP) provides a unique capability not provided by LEC Intelligent Networks. The CRP allows subscribers to AT&T's 800 services (such as an airline) to control call routing based on real-time operational data, available only to the airline, such as number of calls waiting for an agent at each call center.

AT&T 800 Network w/Customer Routing Point (CRP)

Customer Site

CRP (SLEE)

STP   STP   NCP (SLEE)

STP   STP

Data Link

ACD

Data Link

Host Computer

Data Links to Other Sites

AT&T Switched Network

SSP

ACD - Automatic Call Distributor
NCP - Network Control Point (AT&T term for SCP)

The Local Loop

Below the central office in the hierarchy of the telephone network is the local loop. The loop connects subscriber devices to the switch.
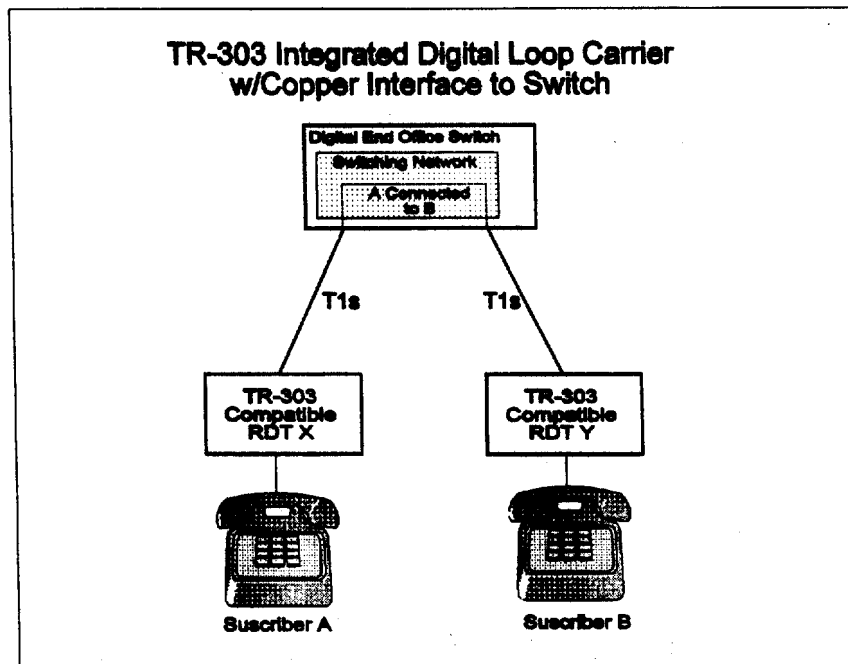
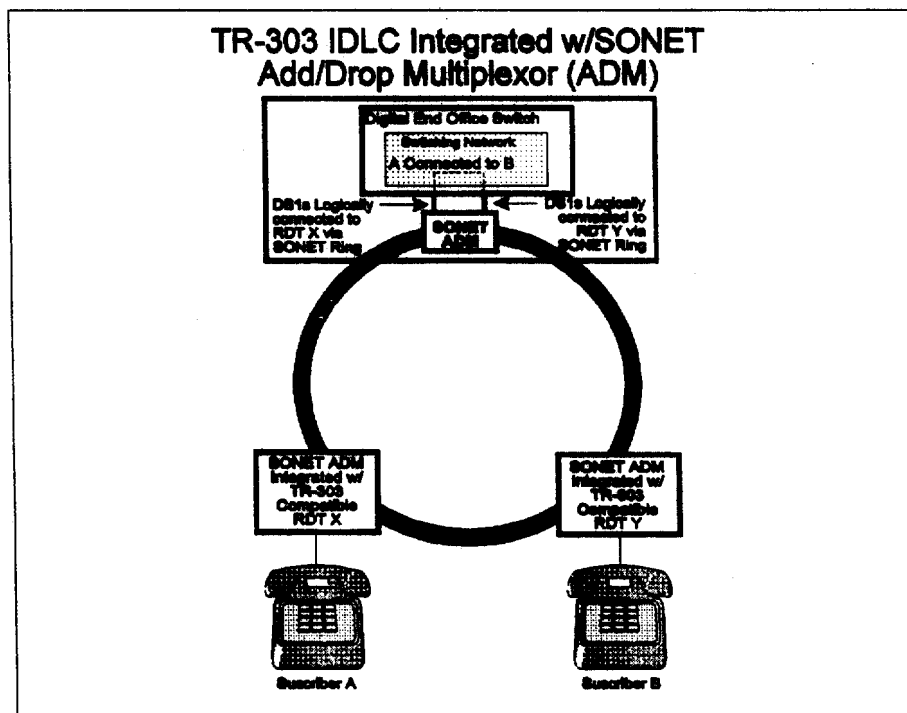### Telephony Local Exchange Network Architecture
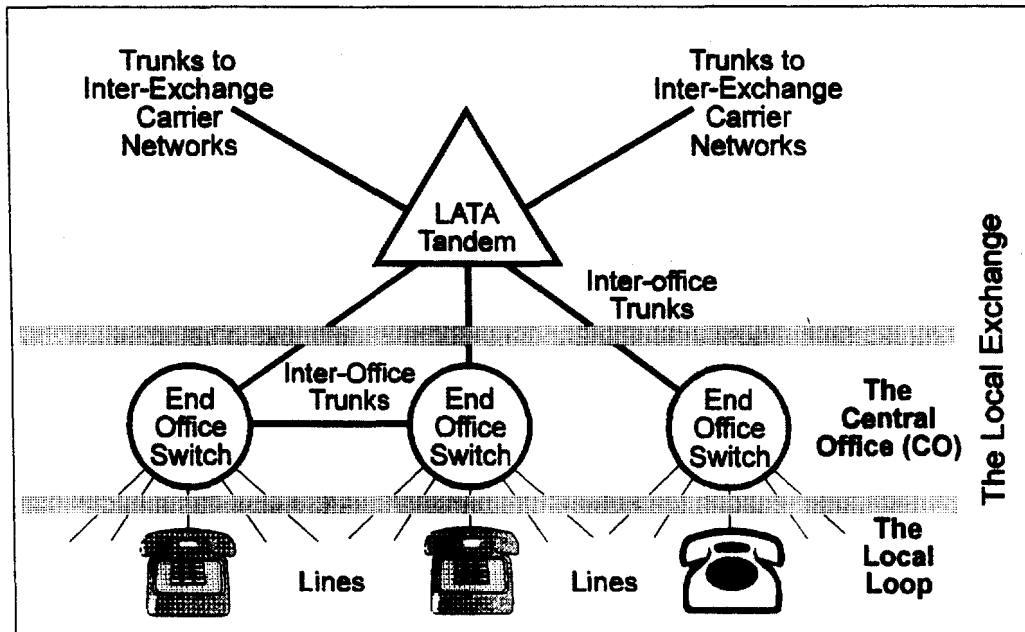
On behalf of its owners, the RBOCs, Bell Communications Research (Bellcore) has been defining a new generation of intelligent network elements (NEs) for transmission in the local loop as well as interoffice networks. Three interrelated NE types are considered key to upgrading the local loop. These are Synchronous Optical Network (SONET), Integrated Digital Loop Carrier (IDLC) and Fiber in the Loop (FITL).

IDLC based on Bellcore TR-NWT-000303 (TR-303, now GR-303-CORE) is a major extension to previous T1 multiplexer/channel bank combinations installed in the loop. Like their unsophisticated predecessors, IDLCs connect to copper pairs from subscribers' sites. These pairs may be plain old telephone service (POTS) lines, Basic Rate ISDN lines, Centrex business sets, or even T1s. In addition to a copper interface to lines, and a copper T1 interface to a CO switch, TR-303 defines an integrated fiber optic interface using SONET.

IDLC systems contain an internal time-slot interchanger (TSI) under the control of powerful fault tolerant internal processors. Time-slot interchange is the principal technique by which digital switches switch calls. The figure below shows two IDLC Remote Digital Terminals connected to a digital CO switch via copper T1s.

TR-303 Integrated Digital Loop Carrier w/Copper Interface to Switch

Digital End Office Switch

Switching Network

A Connected to B

T1s   T1s

TR-303 Compatible RDT X

TR-303 Compatible RDT Y

Suscriber A   Suscriber B

Connection between subscribers on two TR-303 compatible Remote Digital Terminals (RDTs) attached to digital End Office switch via point to point copper T1 facilities.

TR-303 IDLC Integrated w/SONET Add/Drop Multiplexor (ADM)

Digital End Office Switch

Switching Network A Connected to B

DS1s Logically connected to RDT X via SONET Ring

DS1s Logically connected to RDT Y via SONET Ring

SONET ADM

SONET ADM Integrated w/ TR-303 Compatible RDT X

SONET ADM Integrated w/ TR-303 Compatible RDT Y

Suscriber A   Suscriber B

Connection between subscribers on two TR-303 compatible RDTs attached to digital End Office switch via SONET ring.

THE EVOLVING ARCHITECTURE OF TODAY'S NETWORK, COMBINING INTELLIGENT SERVERS WITH INTELLIGENT TRANSMISSION EQUIPMENT IN THE LOOP
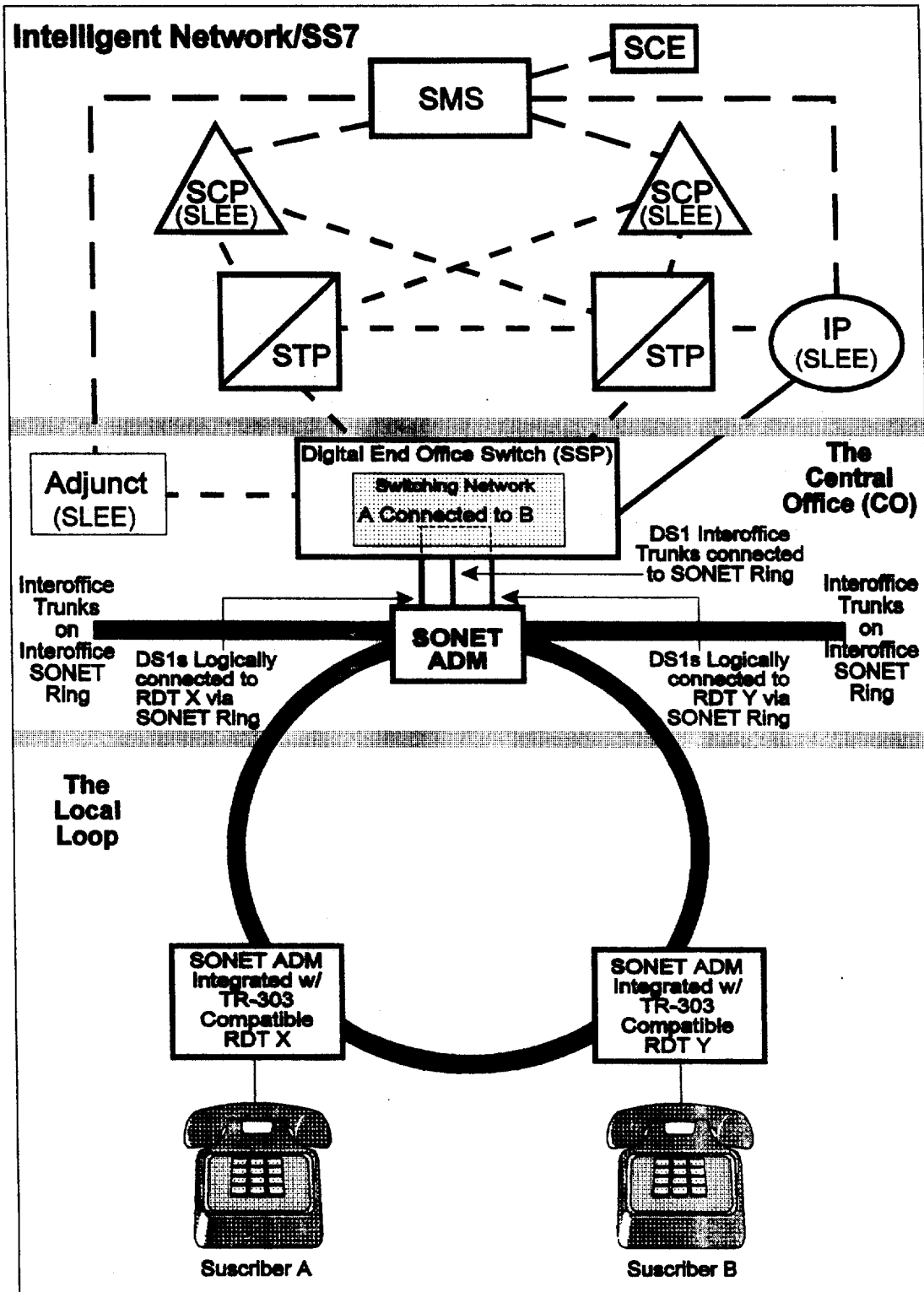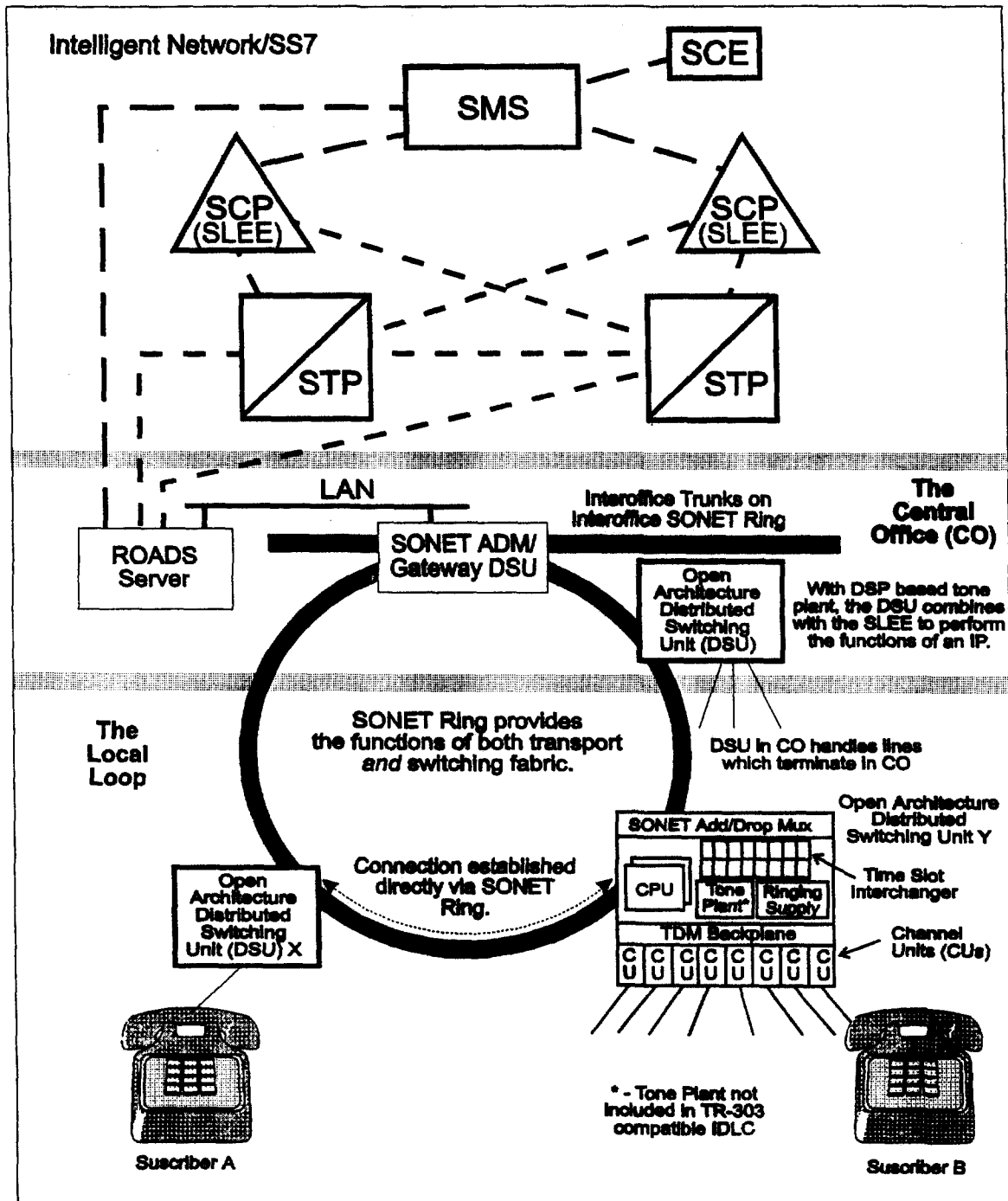
The figure above shows the combination of Intelligent Networking with intelligent transmission equipment in the local loop. This is the architecture toward which today's network is evolving. As can be seen, technology developed in the last five to ten years surrounds the CO switch, which itself is based on technology nearly two decades old.

In the diagram below, we see what is inside a TR-303 compatible IDLC with an integral SONET multiplexer. Add a tone plant and you would have a Switching Unit. We call a TR-303 IDLC platform with the addition of a tone plant, a Distributed Switching Unit (DSU). The call processing control within a TR-303 IDLC comes via signaling messages from the switch. These messages could just as easily come from an IN based server.

TR-303 IDLC Integrated w/SONET Add/Drop Multiplexor (ADM) Showing RDT Detail
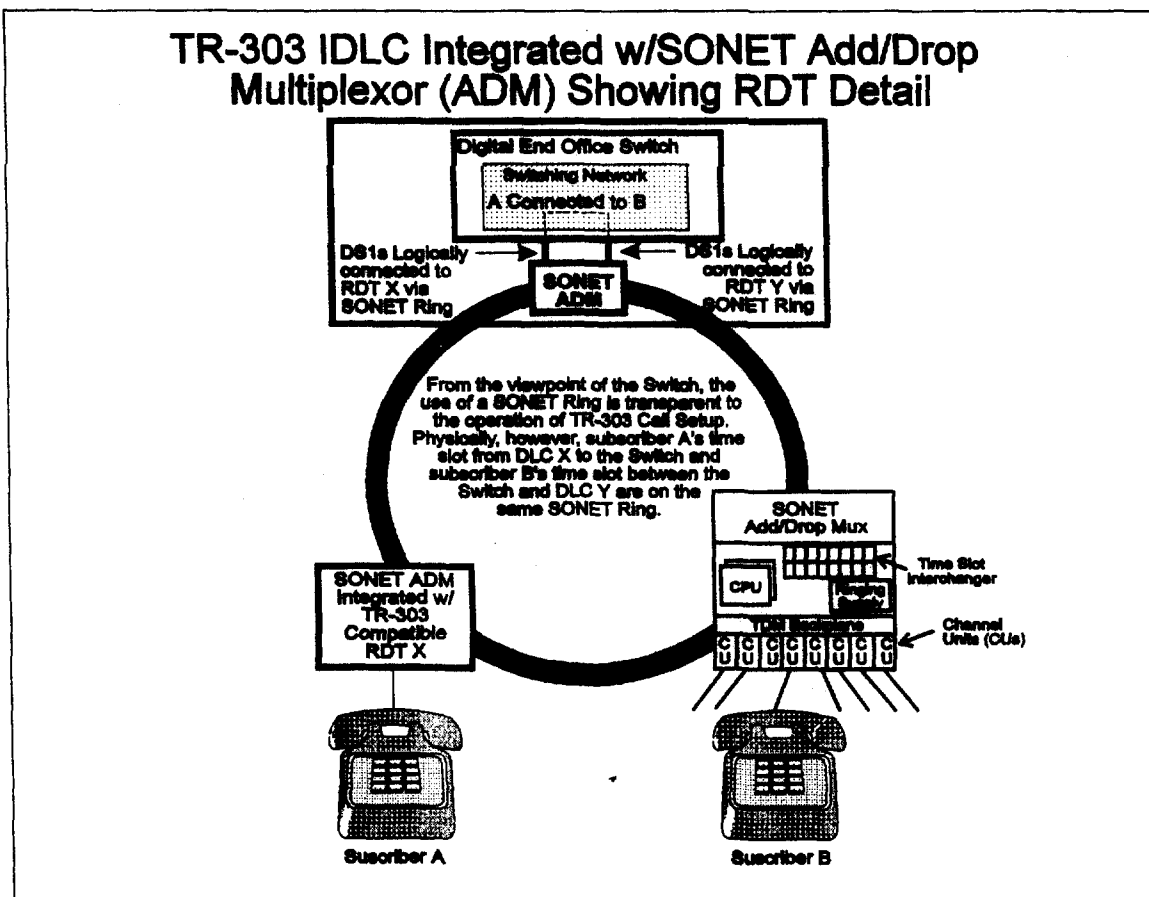
## ROBUST OPEN ARCHITECTURE DISTRIBUTED SWITCHING MODEL

The figure above shows the next logical step. Control the intelligent transmission equipment directly from an IN based server and retire the CO switch.

INCUMBENT LEC NETWORK APPLICATIONS

The figure above illustrates how the ROADS Model can be applied to replace a CO switch. However, cutting over an entire switch to the ROADS Model requires a commitment to this radical technology which few LECs can be expected to make. Fortunately, the scalability and distributed nature of this model allows a less revolutionary approach to be taken for introduction of this technology in the Public Switched Network.

At the 1992 National Fiber Optic Engineering Conference (NFOEC), Eaves and Zimmerman of Bellcore presented a concept which would allow LECs to introduce new services throughout a LATA without having to upgrade hardware and software at each Central Office. To accomplish this, TR-303 compatible RDTs would be installed in COs. Such an approach limits a carrier's financial risk in introducing a new service, such as ISDN, where customer demand is uncertain. The figure below illustrates Eaves' and Zimmerman's approach.
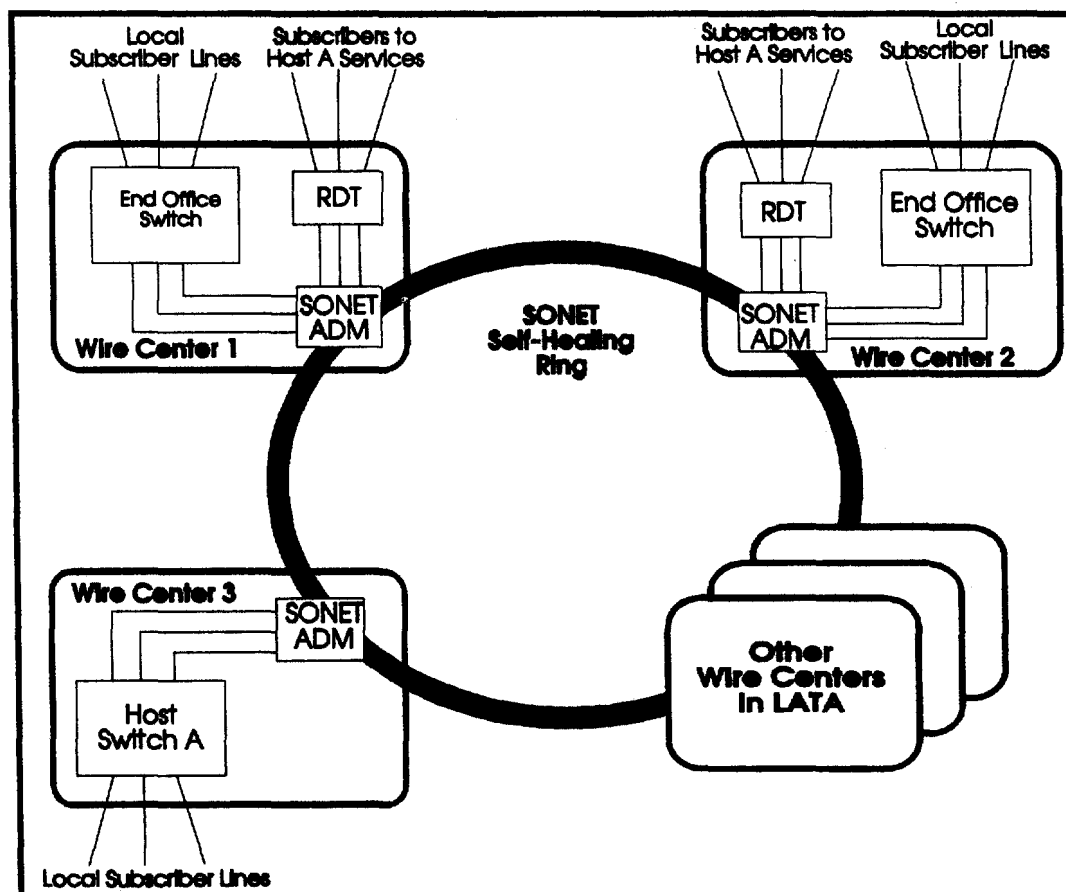
Host switch in wire center 3 provides ISDN or other services to subscribers subtended from TR-303 compatible RDTs in other wire centers. This enables LECs to provide advanced services without incurring the cost of upgrading switches in all wire centers to support ISDN.

Eaves and Zimmerman had the vision to realize that a TR-303 compatible RDT is both a powerful platform for service delivery and a cost effective, scalable, way to introduce advanced services throughout the Local Exchange. The figure below shows how the approach described by Eaves and Zimmerman relates to deployment of the ROADS Model.

LEC NETWORK EVOLUTION TO ROADS MODEL
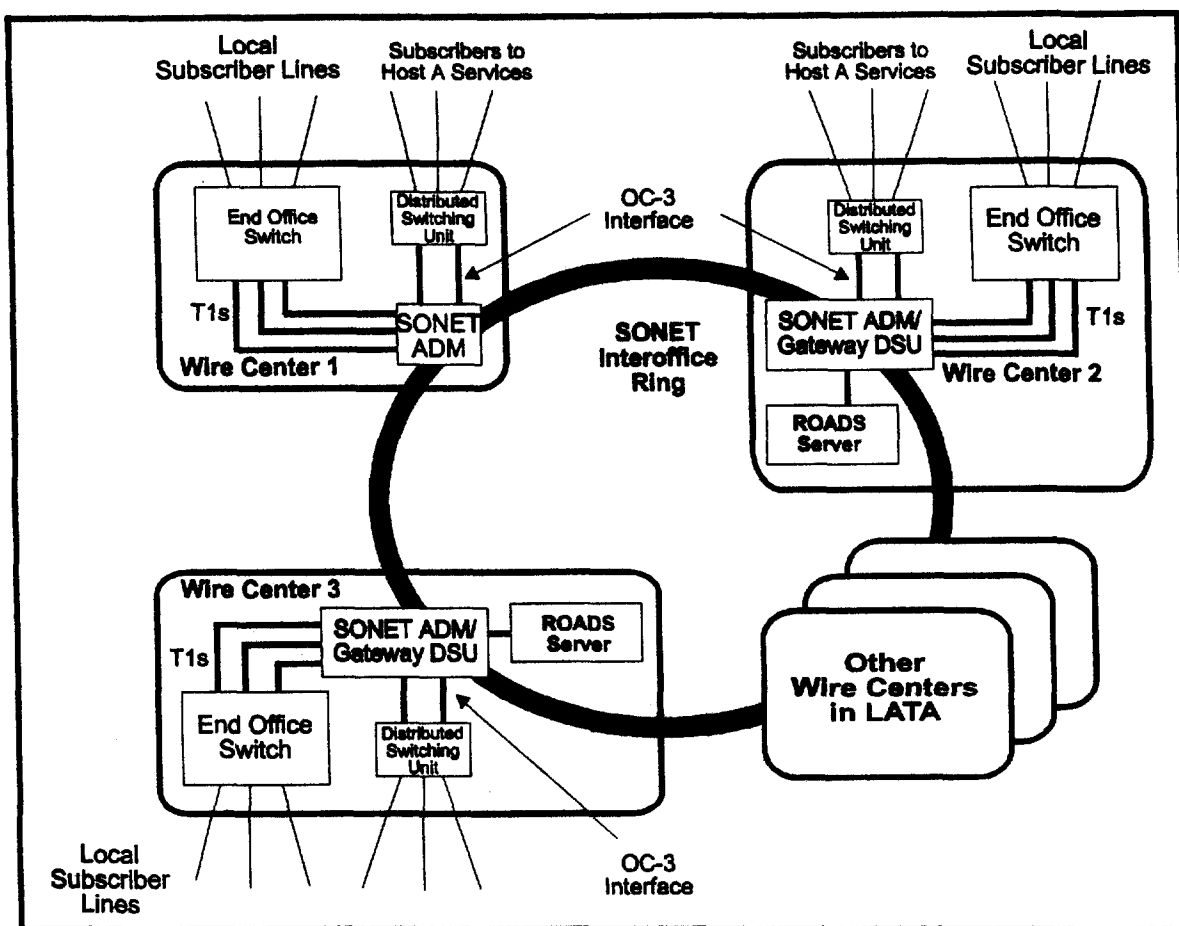
Distributed switching units in each wire center offer advanced services rather than upgrading older switches based on centralized proprietary architectures. This allows the Robust Open Architecture Distributed Switching model to be introduced with very low risk. Note that ROADS servers, located at diverse wire centers, act as fault tolerant servers for call processing and element management of distributed switching units.

# PERSONAL COMMUNICATIONS SYSTEMS (PCS) NETWORK APPLICATIONS

Bellcore TR-NWT-001313 (TR-1313) provides Generic Criteria for Version 0.1 Wireless Access Communications Systems (WACS). TR-1313 suggests several models for interfacing an RF equipment vendor's Remote Radio Port Control Units (RPCUs) to a switch. Among the models suggested is the Digital Loop Carrier (DLC) model.

TR-303 provides an open interface for providing wireless personal communications services using either cable or conventional copper for connection of distributed RF equipment with the telephony backbone. Several RF manufacturers, including Motorola, are supporting the TR-303 interface in their PCS offerings.

PERSONAL COMMUNICATIONS SYSTEMS NETWORK ARCHITECTURE
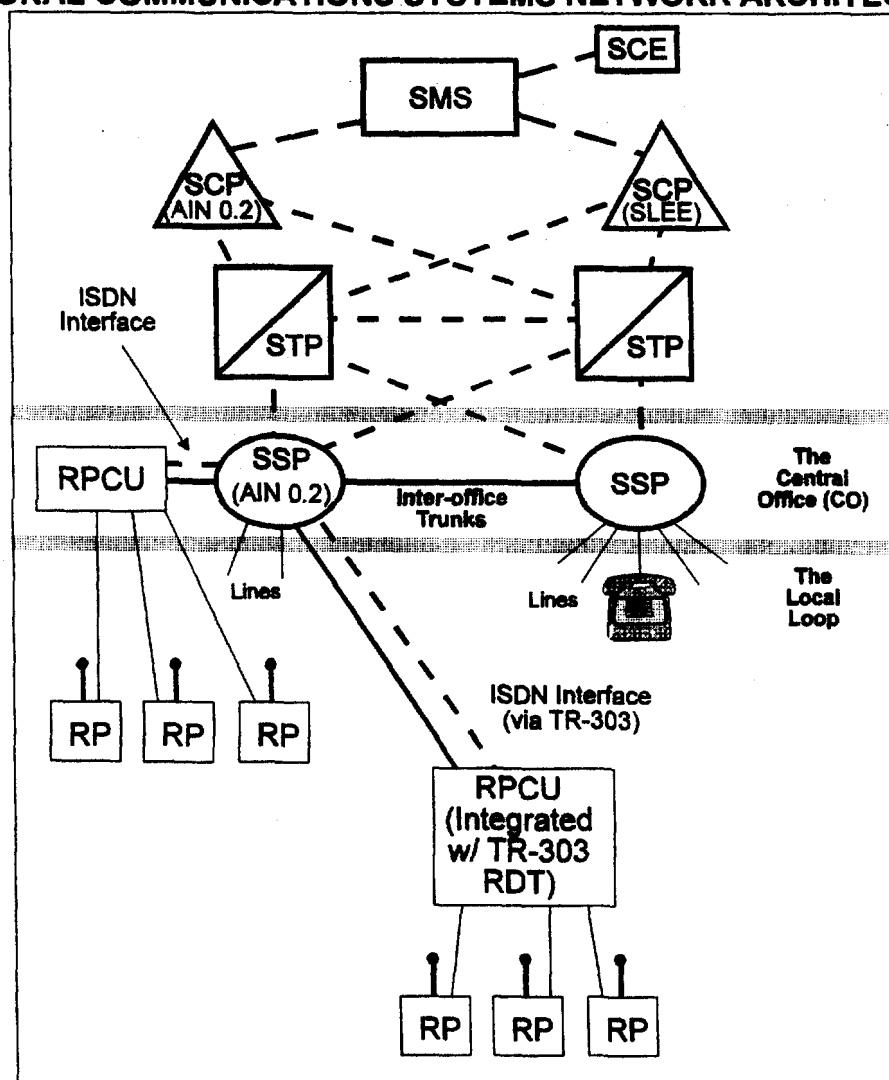
# PERSONAL COMMUNICATIONS SYSTEMS USING THE ROADS MODEL
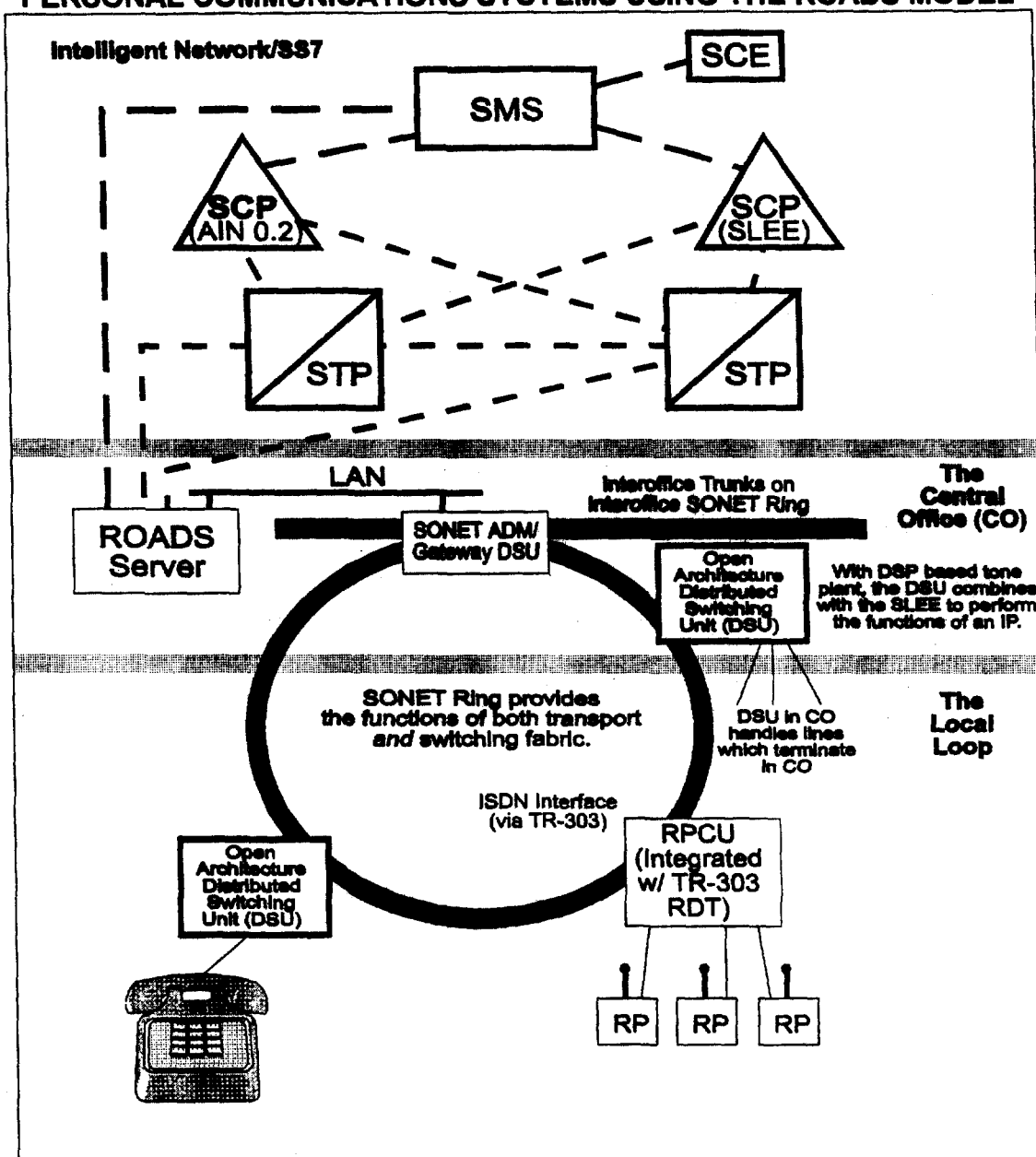
The figure above illustrates the network in the previous figure converted to ROADS. This approach can be implemented with minor hardware additions to a TR-303 telephony interface and with IN-based servers which provide all switching features. The servers can be located at central offices, regional hubs or other convenient sites. Each server interfaces to the SS7 network for signaling with IXCs, with the incumbent LEC and with other third party local carriers in the area.

CABLE TELEPHONY NETWORK APPLICATIONS

CableLabs, the "Bellcore" of the cable industry has proposed the Regional Hub architecture for delivery of video and telephony services. The figure below shows the overall architecture for cable telephony with conventional digital end office switches at Regional Hubs. A network of SONET rings would connect head ends to switches at Regional Hubs.

CABLE TELEPHONY NETWORK ARCHITECTURE
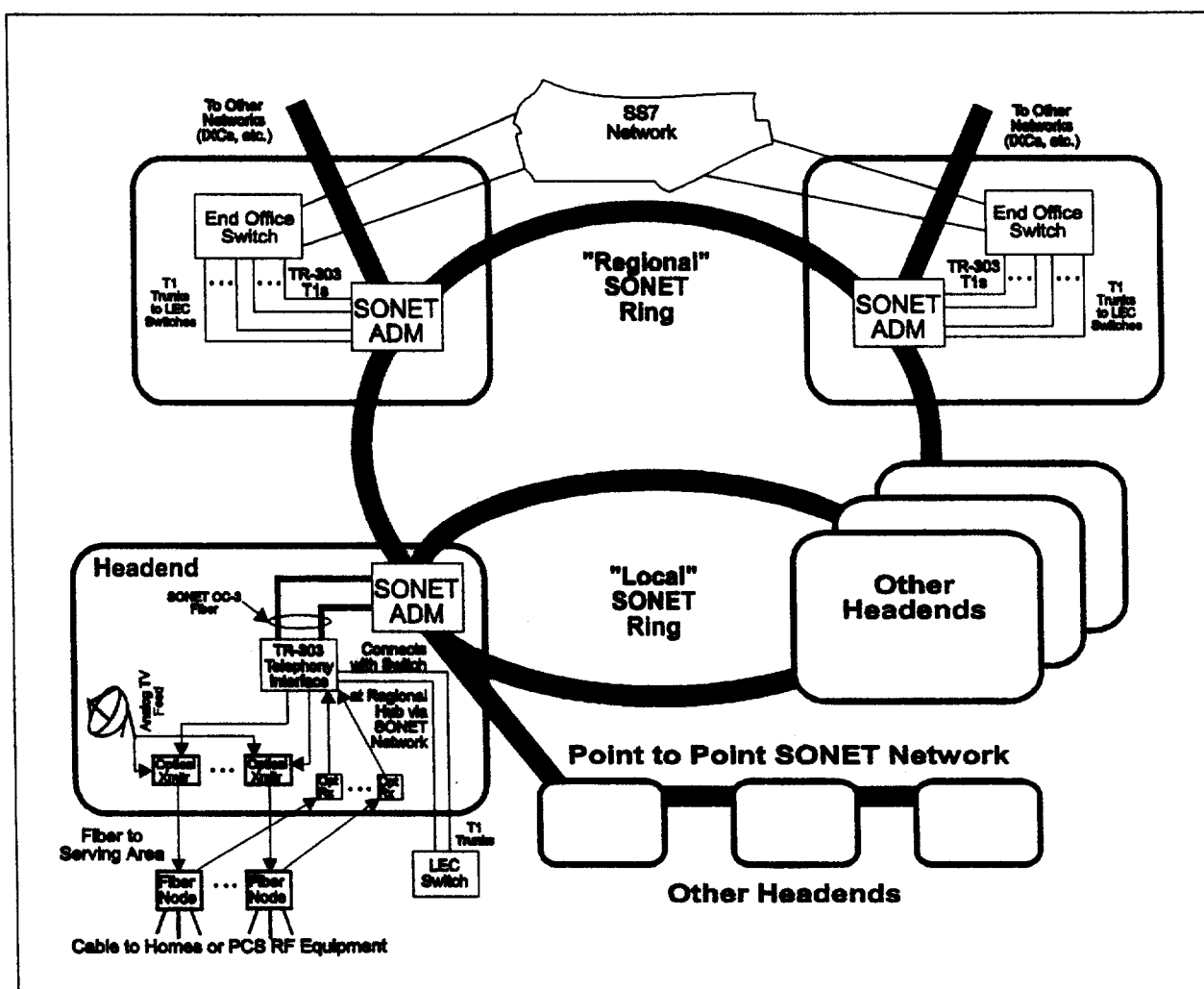
Cable TV operators are upgrading their networks with fiber from the head ends to fiber nodes in the outside plant. The purpose of these upgrades is to improve reliability and signal quality for TV viewers by eliminating many RF repeaters otherwise necessary with cable only installations. The fiber runs do not require repeaters and do not pick up electromagnetic interference. This approach also facilitates cable telephony by providing separate upstream paths from each fiber node.
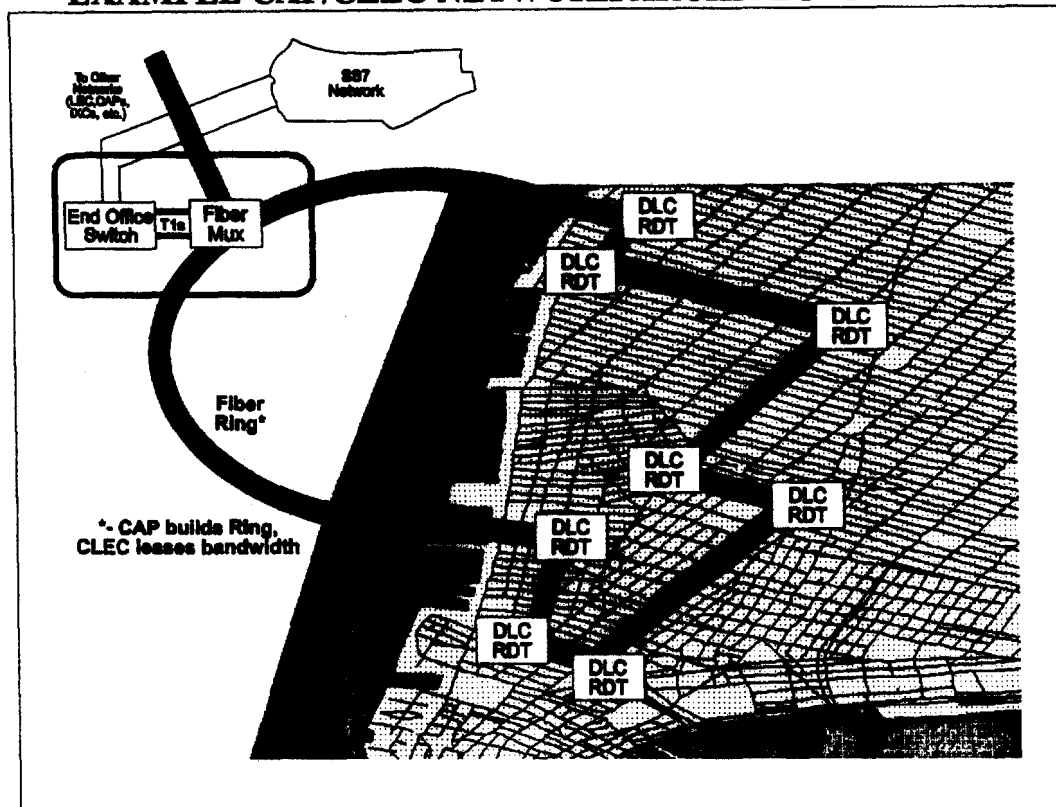
The figure below illustrates the network in the previous figure converted to the ROADS Model.

CABLE TELEPHONY DEPLOYMENT USING THE ROADS MODEL
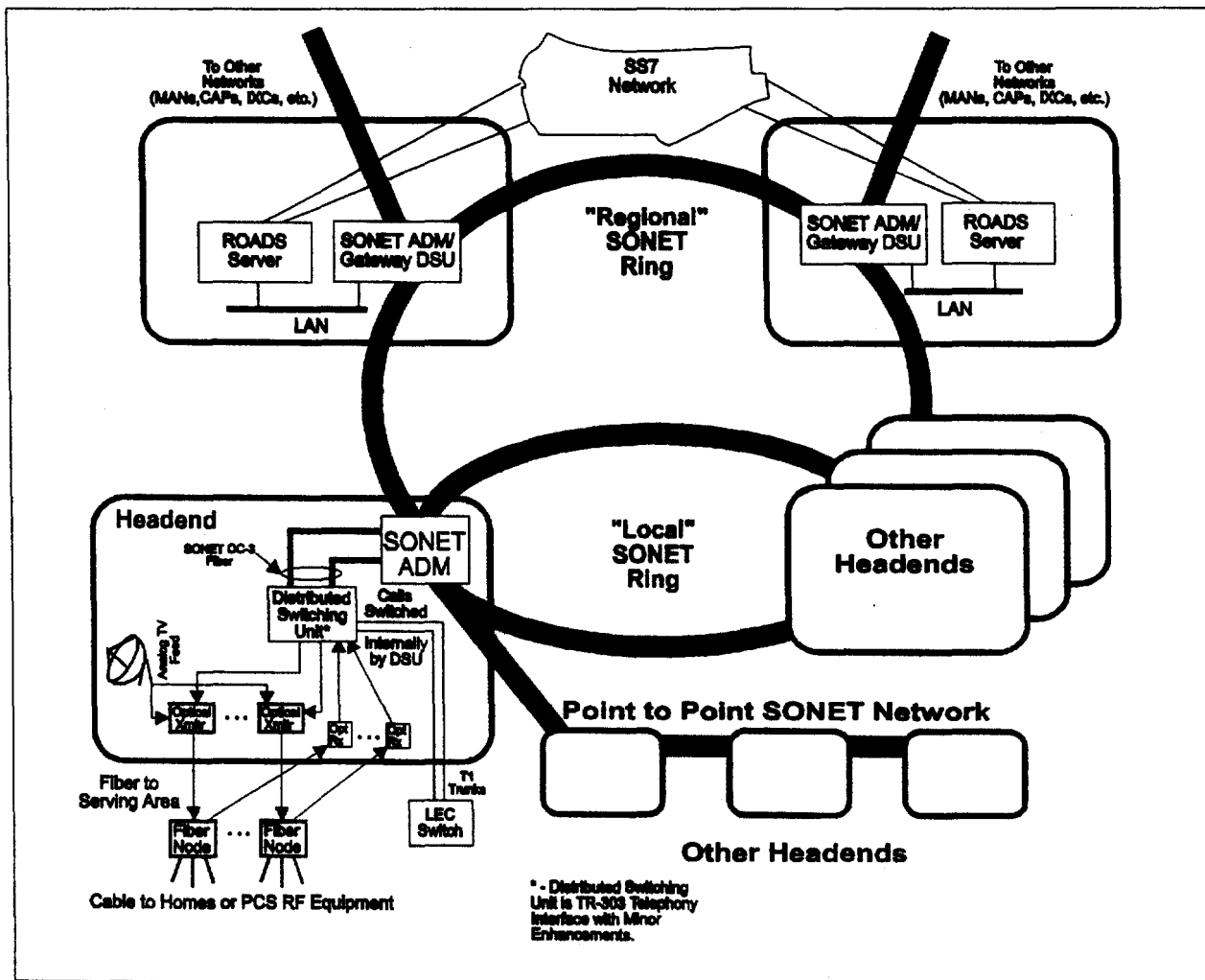
COMPETITIVE ACCESS PROVIDER AND COMPETITIVE LOCAL EXCHANGE CARRIER NETWORK APPLICATIONS

EXAMPLE CAP/CLEC NETWORK ARCHITECTURE

Competitive access providers initially deployed fiber networks in metropolitan areas, overbuilding incumbent LEC networks. CAPs leased dedicated facilities to large businesses which wanted diversely routed links to increase survivability. CAP networks have since evolved to include switched services as well as strictly "pipe." CAPs which provide switched could also be called Competitive Local Exchange Carriers (CLECs), but CLECs generally lease bandwidth from Incumbent LECs (ILECs), IXCs or CAPs.

Rather than deploying many switches throughout an area, as the ILECs have done over the last 100+ years, CAPs and CLECs are all backhauling traffic from DLC RDTs in customer buildings and ILEC end offices to centralized switches (a la Eaves and Zimmerman).

CAPs have implemented SONET in some areas but legacy proprietary fiber multiplexers are still plentiful. The figure above shows a hypothetical CAP network with a fiber ring in Manhattan based on proprietary multiplexers. Customer lines connect to conventional TR-08 compatible digital loop carrier equipment installed in large office buildings which connect to a digital end office switch via the fiber ring. A single switch can provide service to an entire metro area since the CAP has limited penetration. While two switches would be more reliable, only one switch is shown in this example network.

The figure below shows the previous network converted to the ROADS Model. SONET is used for the ring and the TR-08 DLCs have been upgraded first to TR-303, and then to become distributed switching units. Since only one switch was included in the previous figure, only one server location is shown. Multiple locations are recommended for added robustness.

CAP/CLEC NETWORK USING ROADS MODEL